PG&E Transition to a Value-at-Risk Approach

- VaR Approaches
- PG&E VaR Proposal
- Implementation
- Next Steps

What is VaR?

What is Value at Risk? Value at Risk (VaR) is a measure of the maximum potential change in value of a portfolio with a given probability over a pre-set horizon.

What is TeVaR? To-expiration Value at Risk is a measure of the maximum potential change in value of a portfolio with a given probability over the holding period of portfolio positions.

Why Use VaR?

Why Use VaR? VaR answers the question: What is the maximum change in portfolio cost with x% probability over a given time horizon (e.g., the holding period of the portfolio).

How does VaR tie into Customer Risk Tolerance limit? The VaR concept introduces an industry-standard measure of how much portfolio costs can increase or decrease during the holding period within a given confidence interval (probability). This can effectively be translated into a risk for a potential rate increase.

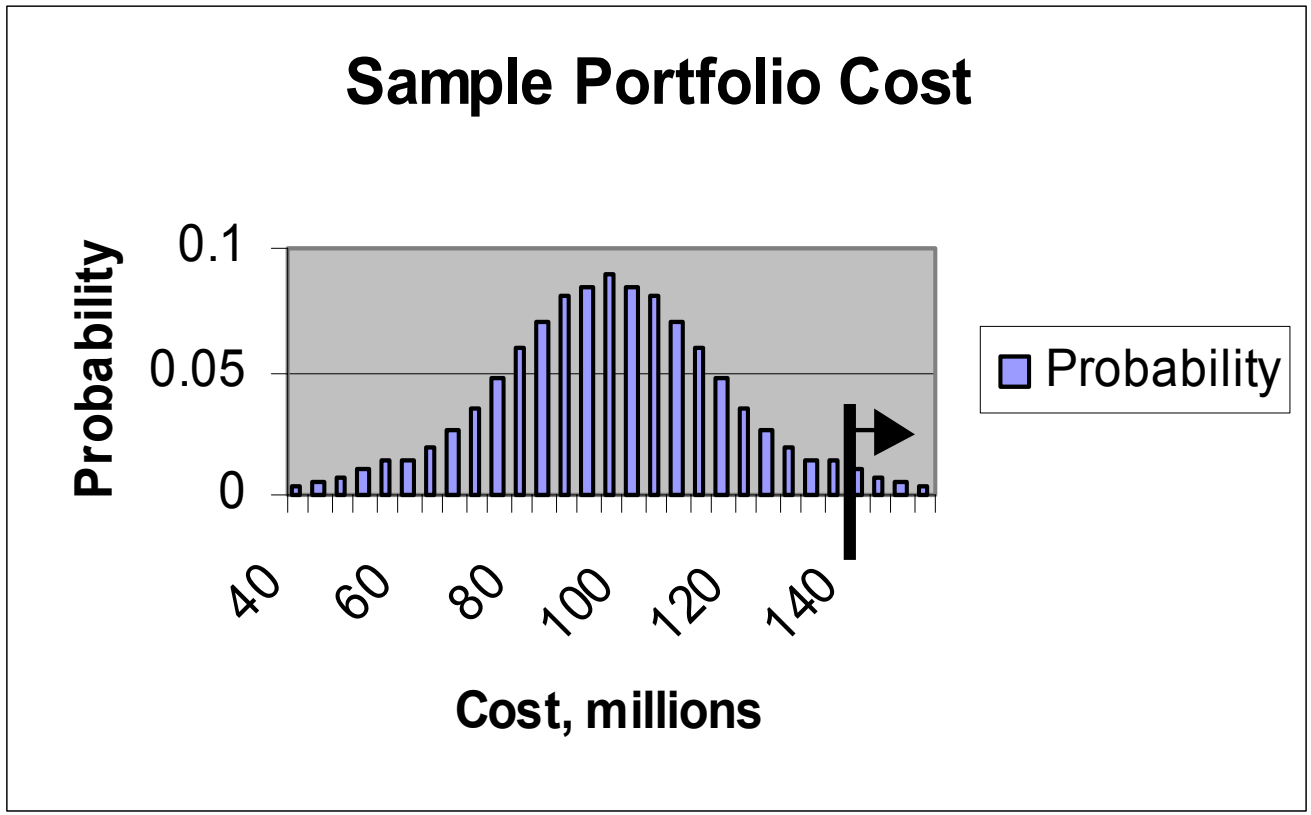
What Risks Are We Trying to Measure?

Factors that affect portfolio cost:

- Price risk
- Market positions, including options
- Location risk
- Load/demand changes
- Weather

VaR effectively represents a way to translate these risks into a probabilistic measure of cost fluctuation.

Sample Risk Profile and VaR



VaR Roadmap

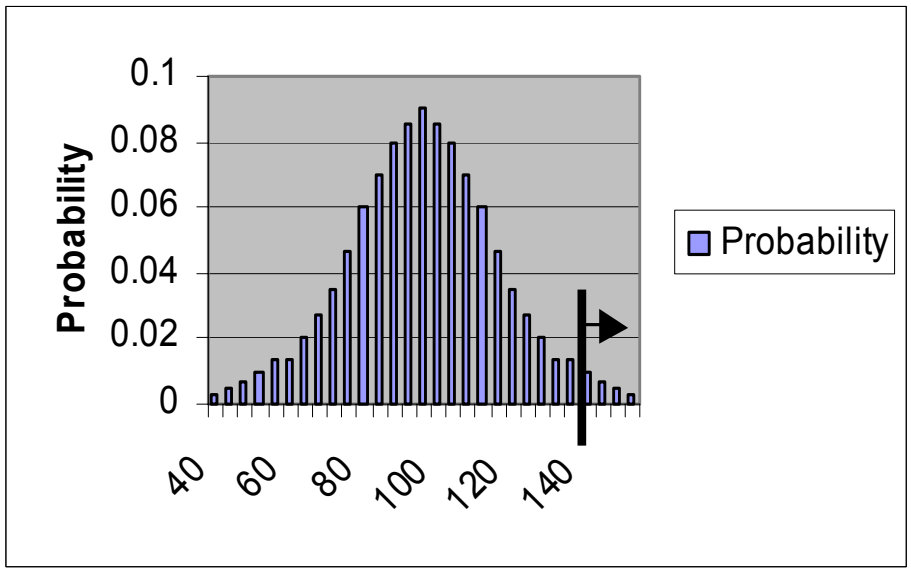
- Approaches
- Periods for VaR Measurement
- Confidence Interval
- PG&E Recommended Approach and Period
- Time Horizon
- Examples

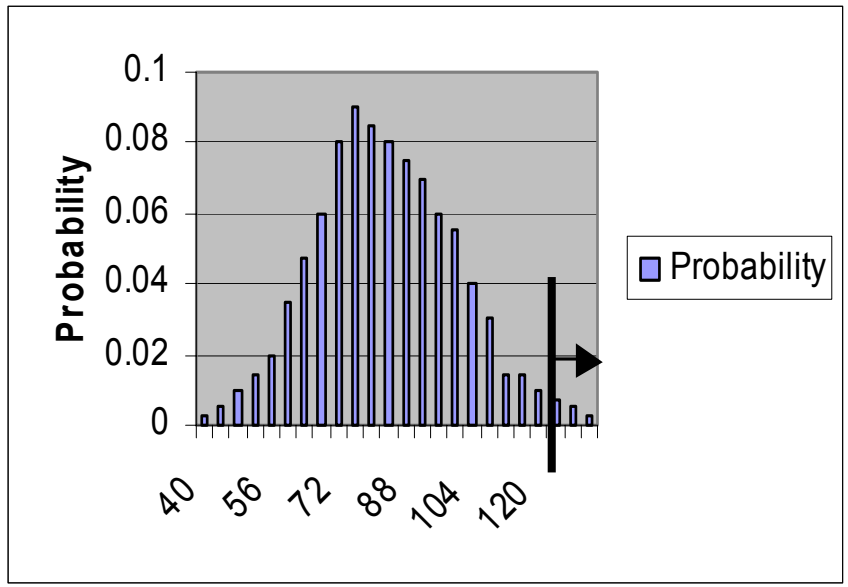
Two VaR Approaches for Consideration

Simulated: Monte Carlo simulation (good for non-linear risk profile)

Linear: Variance-Covariance calculation (good for linear risk profile)

Linear vs. Non-Linear Risk Profiles





A linear risk is one where the change in the value of a position in response to a change in market price is a constant proportion of the change in the price or rate

A non-linear risk is best described by example, like an option exposure. An option's value responds differently to changes in the value of the underlying instrument.

Simulation Based VaR

- Approach allows for an improved representation of
  - price risk
  - market positions including options
  - location risk
  - load
  - weather (hydro)
- Allows profiles of risk drivers to be non-linear
- Varying distribution types can be handled

Implications

- Calculations take more time to set up, and results longer to produce
- Laborious to create sub-portfolio reports (e.g., load, hydro, location risk)

Linear VaR

- Computationally easier to seek optimal hedging strategies
- Easy to create sub-portfolio risk reports (layering in sensitivities)
- Works well for short time horizons and low volatility because distributions are almost normal

Implications

- Misrepresents variables that do not have normal distributions (such as options). Therefore, not recommended as a measure for ***total*** portfolio risk exposure.

Periods for VaR Measurement

Daily VaR	**To-Expiration VaR**
Assumes one day liquidation period at forward price	Assumes carrying positions to delivery, and delivery price is simulated market spot price
More applicable to a commodity portfolio that through trading can be unwound quickly	More applicable to an IOU portfolio of assets and load with inherently non-linear characteristics and spot risks such as weather and load
Acceptable for reporting of price risk, but not for volumetric or weather risk	Ideal for IOU portfolio risk limit reporting

TeVaR is effectively the same as ratepayer cash flow at risk (CFaR) if electric portfolio positions were the only ones affecting rates.

VaR Confidence Intervals

- **Simulated VaR**
  - Will use a downside (1-tail) risk at 95% confidence level
  - Distributions are not symmetric

- **Linear VaR**
  - Will also use a downside (1-tail) risk at 95% confidence level
  - Symmetric distributions are assumed

PG&E Recommended Use of VaR

- Period: To-Expiration VaR (TeVaR)
- Method:
  - Simulated (total portfolio)
  - Linear Approximation (sub-portfolio analysis, optimal hedging strategies)

PG&E Recommended Use of VaR

Portfolio-Level View

PG&E's portfolio contains a significant amount of non-linearity due primarily to optionality of assets, contracts and load.

Therefore, a Simulation-Based TeVaR is the appropriate measure for the total portfolio risk.

PG&E Recommended Use of VaR

Sub-Portfolio View, Incremental Hedging Strategies

PG&E must also analyze sub-portfolio risks and seek to mitigate risks via optimal hedging of the underlying products. Simulated TeVaR is cumbersome to use for seeking the optimal mix from scratch because:

1. Computationally intensive even for a simple optimization and would take too long
2. It is non-linear and therefore non-transparent in the way the optimal mix is chosen.
3. Only heuristic checks are possible, not validation

Given this, a linear approximation to TeVaR can still be valuable to seek an initial optimal mix and then its impact can be assessed using simulation.

VaR Time Horizon

Time Horizon: PG&E will use a rolling 12-month time horizon in measuring TeVaR. Reasons: Procurement plan time horizon, liquidity of forward market, increased likelihood of a good spectrum of price volatility data, risk measure assumptions tend to break down over longer time horizons

Statistical Techniques:

Simulated TeVaR: Monte Carlo simulation (total portfolio).

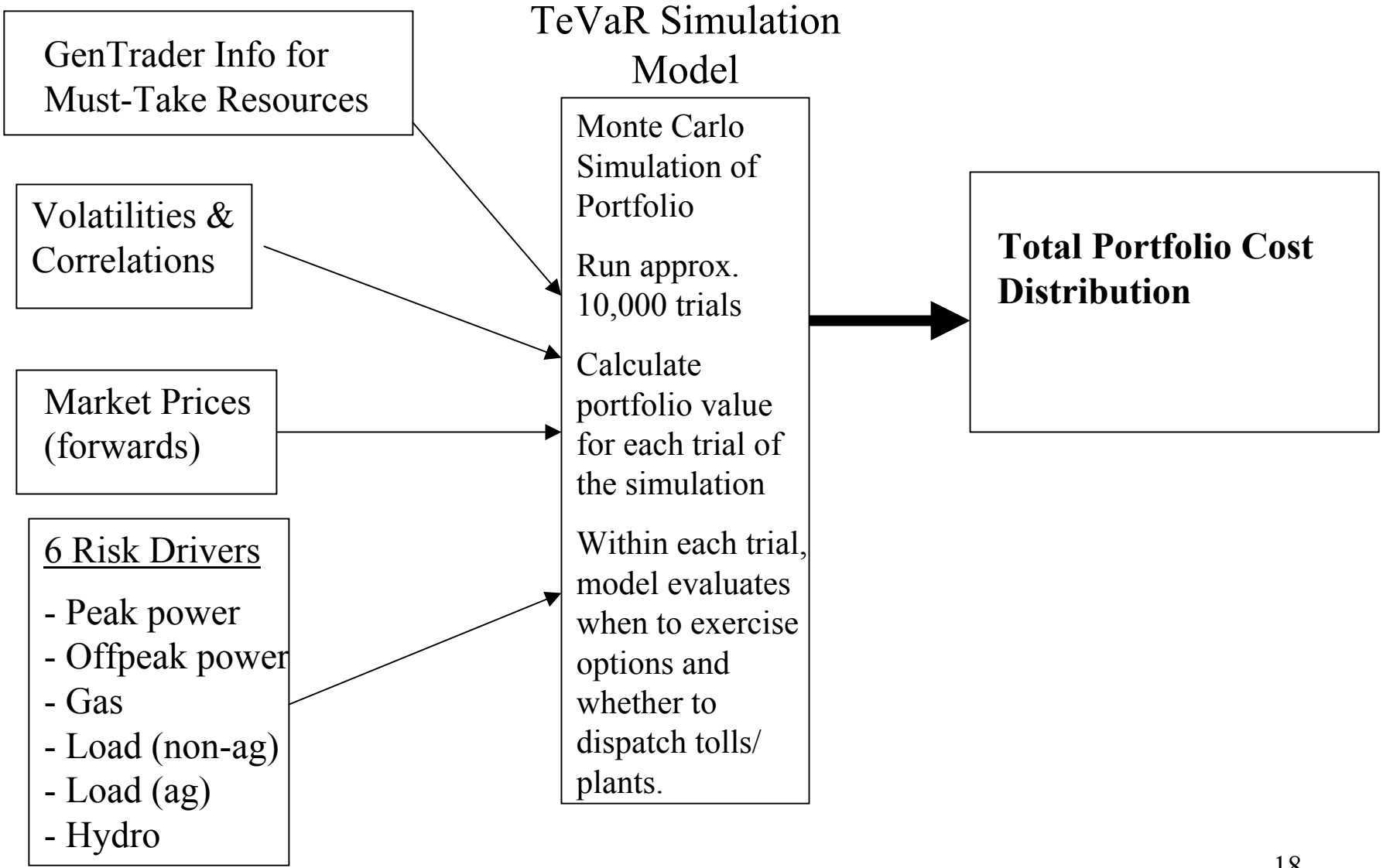
Linear TeVaR: Variance-Covariance calculation (sub-portfolio, incremental hedging strategies).

Simulated TeVaR Technique

Monte Carlo Simulation

- Varying distribution of prices, market positions, load, weather
- Calculate a portfolio value for each trial of the simulation
- Within each trial, model evaluates when to exercise options and whether to dispatch tolls / plants

Schematic – Simulated TeVaR

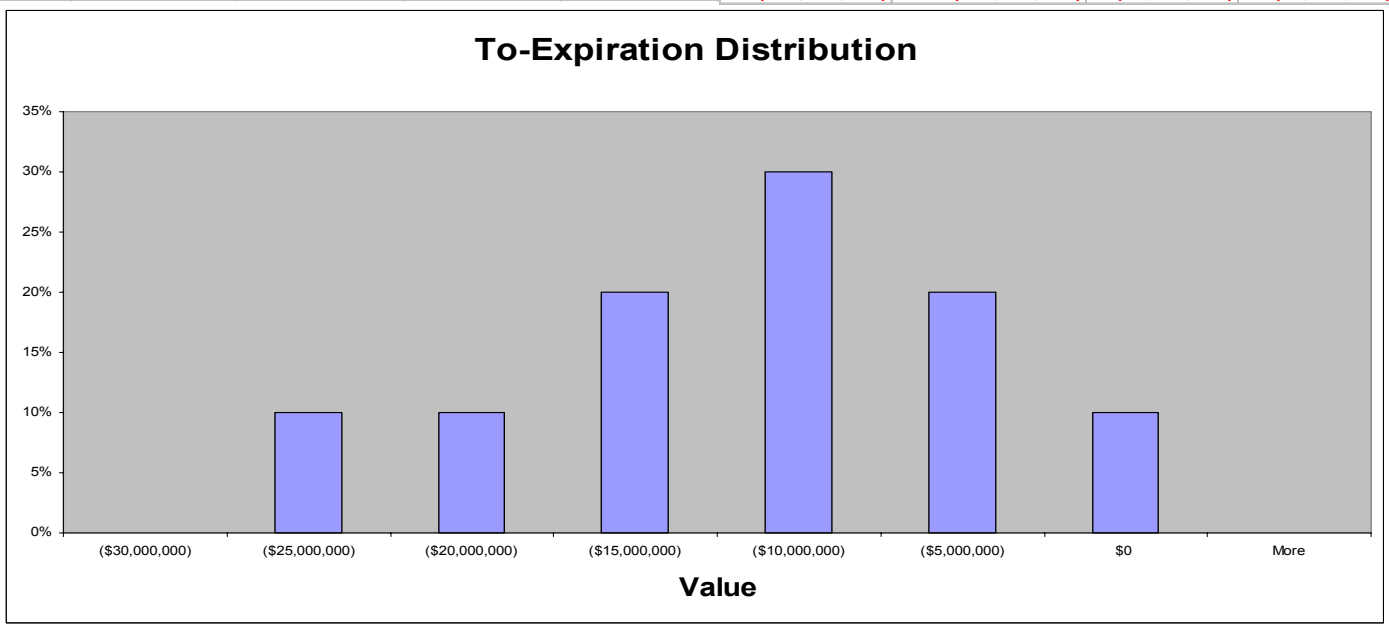


Sample Simulated TeVaR Calculation

Example Simulated TeVaR Calculation incorporating Load Variability								
Today	4/23/2003							
# of Trials	10							
			Price Volatility	Volumetric Stdev			Expiration Price	Expiration
	Fwd Price	Distribution			Trading Days	# Yrs		
NP-Jun-03	$50.00	Lognormal	67%	-	38	0.15	26%	
NP-Jun-03	$60.00	Lognormal	78%	-	60	0.23	37%	
Gas-Jun-03	$4.50	Lognormal	55%	-	38	0.15	21%	
Gas-Jul-03	$4.00	Lognormal	63%	-	60	0.23	30%	
Load Variability Jun-03	$50.00	Normal		350,000	38	0.15		133,549
Load Variability Jul-03	$60.00	Normal		150,000	60	0.23		71,919
Correlation Matrix	NP-Jun-03	NP-Jul-03	Gas-Jun-03	Gas-Jul-03	Load Var Jun-03	Load Var Jul-03		
NP-Jun-03	**100%**	75%	90%	50%	0%	0%		
NP-Jul-03	75%	**100%**	85%	40%	0%	0%		
Gas-Jun-03	90%	85%	**100%**	80%	0%	0%		
Gas-Jul-03	50%	40%	80%	**100%**	0%	0%		
Load Variability Jun-03	0%	0%	0%	0%	**100%**	0%		
Load Variability Jul-03	0%	0%	0%	0%	0	**100%**		

Sample Simulated TeVaR Calculation

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
NP-Jun-03	$99.10	$35.83	$31.97	$62.05	$78.93	$85.53	$33.04	$41.49	$67.83	$48.69
NP-Jun-03	$92.85	$43.76	$41.29	$72.46	$85.05	$70.08	$46.04	$55.24	$70.85	$51.51
Gas-Jun-03	$13.15	$4.16	$3.20	$5.28	$6.87	$4.69	$2.51	$2.99	$6.67	$4.31
Gas-Jul-03	$5.82	$3.11	$2.96	$4.90	$5.26	$6.30	$3.11	$3.58	$4.83	$3.42
Hydro Jun-03	(38,310)	4,260	4,181	3,306	(11,400)	(115,165)	(250,132)	107,570	138,331	(277,922)
Hydro Jul-03	(93,560)	(71,162)	1,612	(66,266)	47,511	(42,439)	(28,833)	1,599	(145,903)	(136,007)
Position										
NP-Jun-03	(53,724)	(58,737)	(55,950)	(24,173)	(48,234)	(151,460)	(187,268)	30,939	67,371	(108,608)
NP-Jun-03	215,721	205,101	266,900	259,908	330,211	242,709	228,550	228,598	139,540	226,506
Gas-Jun-03	(1,858,000)	(2,256,005)	(2,380,080)	(2,257,455)	(2,388,120)	(1,659,005)	(2,788,005)	(1,780,000)	(1,488,790)	(2,150,065)
Gas-Jul-03	(3,173,000)	(3,706,005)	(3,880,080)	(3,657,455)	(3,888,120)	(3,159,005)	(4,288,005)	(3,280,000)	(2,988,790)	(3,650,065)
Value										
NP-Jun-03	($5,324,152)	($2,104,393)	($1,788,845)	($1,499,913)	($3,806,975)	($12,954,927)	($6,188,022)	$1,283,776	$4,569,995	($5,288,164)
NP-Jun-03	$20,030,055	$8,975,796	$11,019,689	$18,832,114	$28,083,205	$17,009,065	$10,522,549	$12,627,956	$9,885,962	$11,667,064
Gas-Jun-03	($24,435,740)	($9,391,447)	($7,610,130)	($11,909,550)	($16,417,603)	($7,776,255)	($6,986,039)	($5,315,869)	($9,931,261)	($9,259,661)
Gas-Jul-03	($18,458,166)	($11,524,054)	($11,473,221)	($17,926,401)	($20,446,873)	($19,917,403)	($13,317,953)	($11,755,177)	($14,437,523)	($12,491,812)
Total Value	**($28,188,003)**	**($14,044,098)**	**($9,852,507)**	**($12,503,750)**	**($12,588,245)**	**($23,639,520)**	**($15,969,465)**	**($3,159,314)**	**($9,912,827)**	**($15,372,573)**

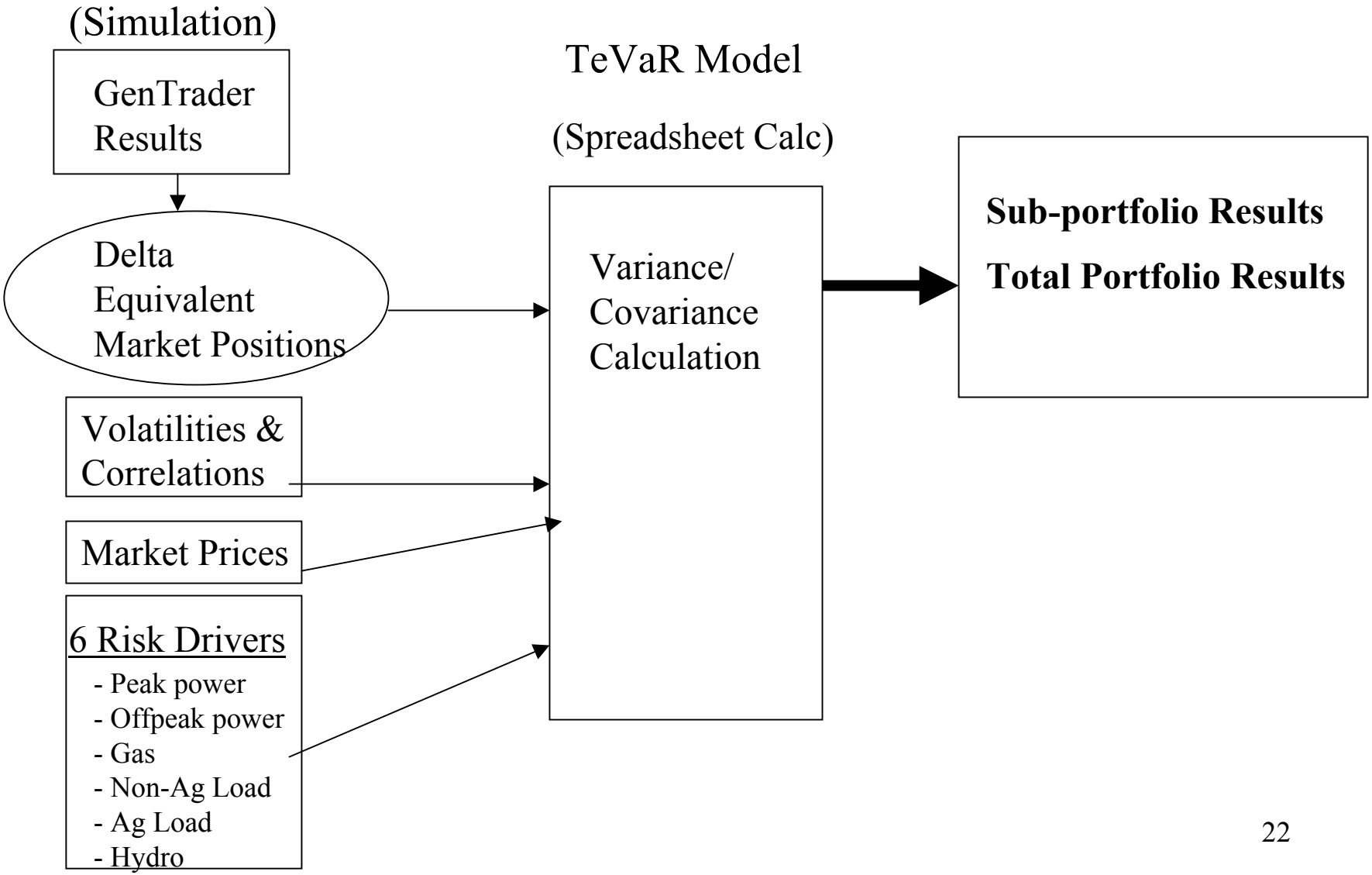


Linear TeVaR Technique

Variance-Covariance Methodology

- Options represented as delta-equivalent positions
- Works well for short time horizons and low volatility because delta-normal approximation for option values in this setting is adequate
- Calculation based on volatilities and correlations of defined positions and/or proxies

Schematic - Linear Approximation TeVaR



Sample Linear TeVaR Calculation

Gentrader Delta Equivalent Market Positions

	Contract Volumes / Provisions							
	Load	Contract #1	Contract #2	…	Contract #n	Net Position	Fwd Price	Market Volatilities
NP-Jun-03	(4,525,700)	100,000	50,000		100,000	80,000	$50.00	75%
NP-Jul-03	(4,850,250)	100,000	50,000		100,000	350,000	$60.00	82%
Gas-Jun-03	0	(1,350,000)	(500,000)		0	(3,500,000)	$4.50	60%
Gas-Jul-03	0	(1,350,000)	(500,000)		0	(4,250,000)	$4.00	50%

	Simulations of Contract Values										
	Trial 1				Trial 2			… Trial X			
	Contract #1	Contract #2	… Contract #n		Contract #1	Contract #2	… Contract #n	Contract #1	Contract #2	… Contract #n	
NP-Jun-03	$ 9,910,000	$ 4,955,092	$ 9,910,000		$ -	$ -	$ 4,149,368	$ -	$ -	$ -	
NP-Jul-03	$ 9,285,000	$ 4,642,576	$ 9,285,000		$ -	$ -	$ 5,524,096	$ -	$ -	$ -	
Gas-Jun-03	$ (17,754,709)	$ (6,575,818)	$ -		$ -	$ -	$ -	$ -	$ -	$ -	
Gas-Jul-03	$ (7,853,301)	$ (2,908,630)	$ -		$ -	$ -	$ -	$ -	$ -	$ -	

Calculate Price Senstivity … …

Delta Equivalent Market Positions

	Load	Contract #1	Contract #2	…	Contract #n	Net Position
NP-Jun-03	(4,525,700)	45,000	40,000		42,275	(50,000)
NP-Jul-03	(4,850,250)	46,250	42,000		77,750	275,000
Gas-Jun-03	0	(607,500)	0		0	(2,000,000)
Gas-Jul-03	0	(624,375)	0		0	(3,500,000)

Sample Linear TeVaR Calculation

Example Linear TeVaR Calculation

Today	4/23/2003						
1-Sided Confidence Interval	95.0%	1.64	Confidence Multiplier				
	Position (mwh, mmbtu)	Fwd Price	Volatility (Annualized)	Trading Days	# Yrs	Expiration Volatility	Price Variance
NP-Jun-03	(50,000)	$50.00	67%	38	0.15	26%	($639,126)
NP-Jul-03	275,000	$60.00	78%	60	0.23	37%	$6,170,693
Gas-Jun-03	(2,000,000)	$4.50	55%	38	0.15	21%	($1,888,760)
Gas-Jul-03	(3,500,000)	$4.00	63%	60	0.23	30%	($4,228,866)

P

Correlation Matrix	NP-Jun-03	NP-Jul-03	Gas-Jun-03	Gas-Jul-03		
NP-Jun-03	**100%**	75%	90%	50%		
NP-Jul-03	75%	**100%**	85%	40%	→	Σ
Gas-Jun-03	90%	85%	**100%**	80%		
Gas-Jul-03	50%	40%	80%	**100%**		

VaR is related to the standard deviation of the portfolio (**P**) value			
The portfolio value's variance is then calculated as	Variance(P) =	**P'** x Σ x **P =**	3.0987E+13
Linear Portfolio TeVar is the standard deviation * confidence multiplier		SQRT(Variance) * 1.64	
	=	SQRT(30986784527288.4) * 1.64	
Linear TeVaR	=	**$ 9,156,202**	

Sample Linear TeVaR Calculation

Example Linear TeVaR Calculation incorporating Load Variability								
Today	4/23/2003							
1-Sided Confidence Interval	95.0%	1.64	Confidence Multiplier					
			Price Volatility	Volumetric			Expiration	Expiration
	Position (mwh, mmbtu)	Fwd Price			Trading Days	# Yrs		
NP-Jun-03	(50,000)	$50.00	67%	0	38	0.15	26%	
NP-Jun-03	275,000	$60.00	78%	0	60	0.23	37%	
Gas-Jun-03	(2,000,000)	$4.50	55%	0	38	0.15	21%	
Gas-Jul-03	(3,500,000)	$4.00	63%	0	60	0.23	30%	
Load Variability Jun-03	-	$50.00		350,000	38	0.15		133,549
Load Variability Jul-03	-	$60.00		150,000	60	0.23		71,919
Correlation Matrix	NP-Jun-03	NP-Jul-03	Gas-Jun-03	Gas-Jul-03	Load Jun-03	Load Jul-03		
NP-Jun-03	**100%**	75%	90%	50%	0%	0%		
NP-Jul-03	75%	**100%**	85%	40%	0%	0%		
Gas-Jun-03	90%	85%	**100%**	80%	0%	0%	→ Σ	
Gas-Jul-03	50%	40%	80%	**100%**	0%	0%		
Load Jun-03	0%	0%	0%	0%	**100%**	0%		
Load Jul-03	0%	0%	0%	0%	0	**100%**		
VaR is related to the standard deviation of the portfolio (**P**) value								
The portfolio value's variance is then calculated as		Variance(P) =	**P'** x Σ x **P** =	9.4196E+13				
Linear Portfolio TeVar is the standard deviation * confidence multiplier =			SQRT(Variance) * 1.64					
		=	SQRT(94195596787824.8) * 1.64					
Linear TeVaR w/ Load Variability		=	**$ 15,964,025**					

Proposed TeVaR Implementation

- Confidence interval - Calculate risk exposure using a downside 95% CI (right-tail exposure for portfolio costs)
- Risk reporting - Simulated TeVaR for the portfolio weekly (internal risk reporting), and monthly (external reporting).
- Hedging Activities (step 1) – Calculate linear TeVaR and use results to estimate the effect of particular hedge strategies
- Hedging Activities (step 2) – Calculate simulated TeVaR for the portfolio to assess the impact of hedges in step 1
- Stress testing -Test portfolio risk exposure against specific stress scenarios for hedge effectiveness and also calibrating the two TeVaR models

Stress Testing

- TeVaR methodology assumes a smooth, continuous market that may "hide" truly outlier catastrophic events
- In addition to TeVaR, scenarios need to be developed to stress test the portfolio for such outlier catastrophic events
- Need to develop risk tolerance limits for these scenarios
- Need to build consensus on which scenarios one should test for and what the risk tolerance is for each scenario
- Complement TeVaR reporting with scenario test reports

Status and Next Steps

- Complete development and testing of Simulation TeVaR Model, scheduled to be complete by April 30
- Submit 2004 Procurement Plan using a Simulated TeVaR and stress testing approach for risk exposure, with comparisons to Linear TeVaR and current approach